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ABSTRACT

This publication provides an introduction to meat processing for adult students in vocational and technical education programs. Organized in four chapters, the booklet provides a brief overview of the meat processing industry and the techniques of meat processing and butchering. The first chapter introduces the meat processing industry and addresses concerns about the need for meat processors in the future and techniques used in the slaughterhouse, as well as providing diagrams of meat cuts. Chapter 2 describes what happens to meat after it reaches the retail market and explains necessary hygiene procedures. Chapters 3 and 4 cover the evaluation and grading of beef and pork, with illustrative photos. Each chapter contains evaluation questions at the end. The final pages of the publication contain a photo essay on the behind-the-counter activities of a retail meat market. (KC)

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**Meat Processing**

**Illinois State Board of Education**

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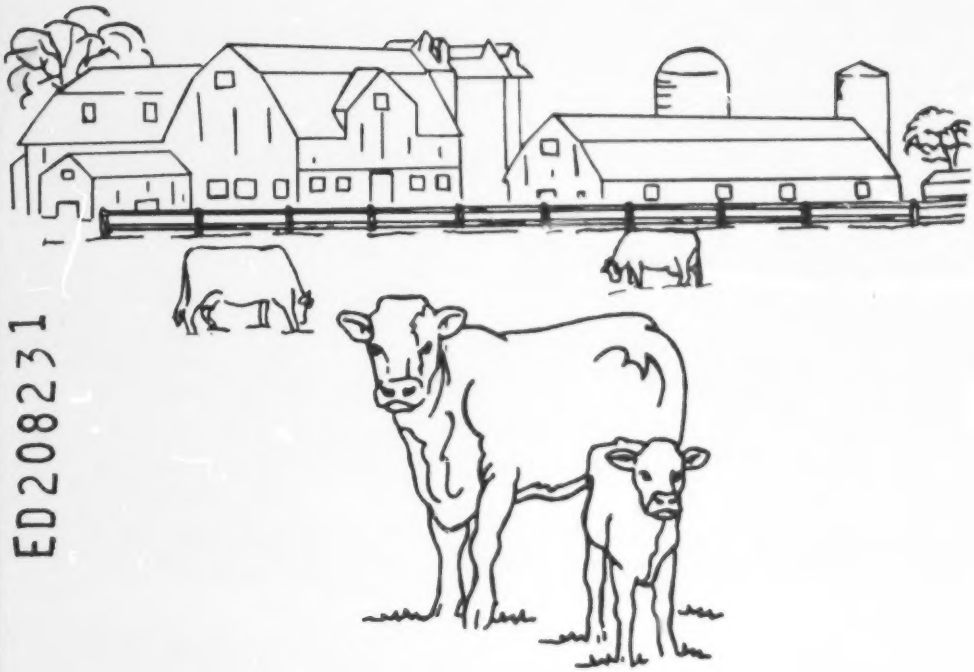

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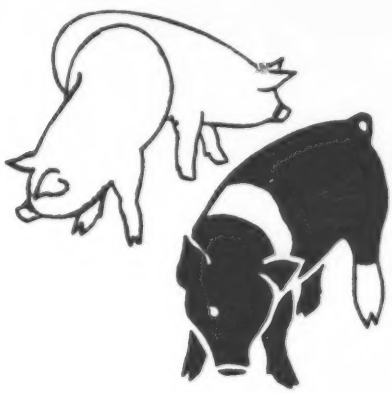

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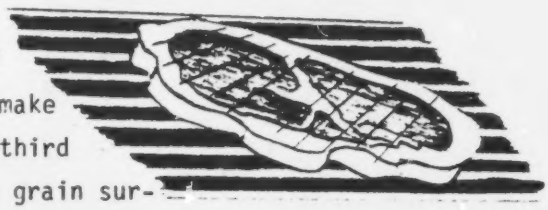
*1981*

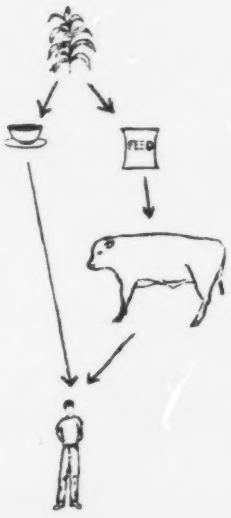
# Chapter One

# Introduction

A question often asked by persons considering the meat industry as a career is, "Will there be a viable meat industry in the years to come?" There are three good reasons to answer "yes" to this question. First, there is a strong American appetite for red meat. Second, much of today's red meat is produced by cattle which graze western lands which could not produce food crops. Our country has vast grasslands which can only be converted to human food indirectly. The ruminant digestive system of sheep and cattle can handle roughage, and so make this otherwise useless land profitable. The third consideration is that our country often has a grain surplus which may allow for increased numbers of animals to be raised and used to provide a red meat food supply.



The meat producer is under constant pressure to produce meat economically. This can be done by: 1) producing meat efficiently, and by 2) maintaining high quality.




Efficiently produced meat can compete with direct use of grain; that is, providing protein more cheaply. This means the producer must seek animals which will produce the most pounds of meat on the least amount of feed.

Maintaining high quality means producing lean animals. A lean animal has a minimum amount of fat. A fat animal is expensive to feed because it takes more energy to produce a pound of fat. In fact, it takes 2 1/4 times as much energy to produce a pound of fat as a pound of lean.

The future for the meat industry is a bright one. The American appetite for cooked red meat will provide the demand. Vast grasslands and grain surpluses will provide the feed for animals. Modern practices to produce efficient and high quality meat are being used to provide the American consumer economical and nutritious red meat.

Since the meat industry will be with us for many years, let's take a look at how the processing of meat works.

At one time, farmers did their own butchering, smoking, and curing of the meat that would be consumed by the family. If time and labor permitted, the farmer may have butchered more animals to be prepared and sold to the general store, where it was made available to the town people. Most sold meat was smoked and cured or dried for preservation purposes at this period.

As farm size increased and livestock producers began to specialize, slaughter houses in major towns began to flourish where vast numbers of meat animals were killed and packaged for sale.

When smaller towns began to form, small slaughter houses, called butcher shops, began to arise in an attempt to bring fresh meat closer to the customer. When they became established, many butchers branched out to include sausage, bacon, and other processed meats in the business. Today there are several types of meat processing businesses. They can be loosely sorted into the following categories:

1. slaughter house
2. branch house
3. breaker
4. boner
5. processor
6. retail butcher
7. locker plant
8. hotel supply house

These eight categories make up the general distribution channels for the meat industry. A flow chart of the distribution channels is shown in Figure 1.

All eight of the categories of meat processing businesses require specialized workers skilled in the art of meat cutting and processing. Skilled workers are in short supply for the meat processing business at the present time.

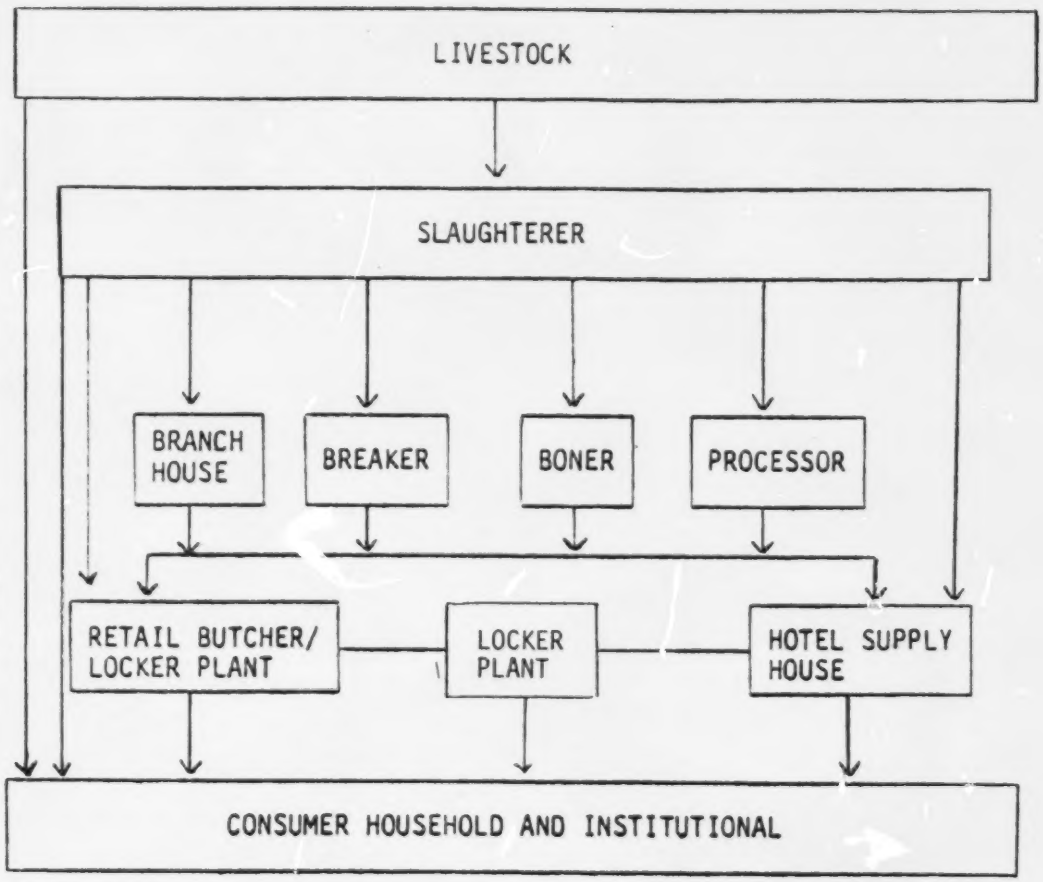
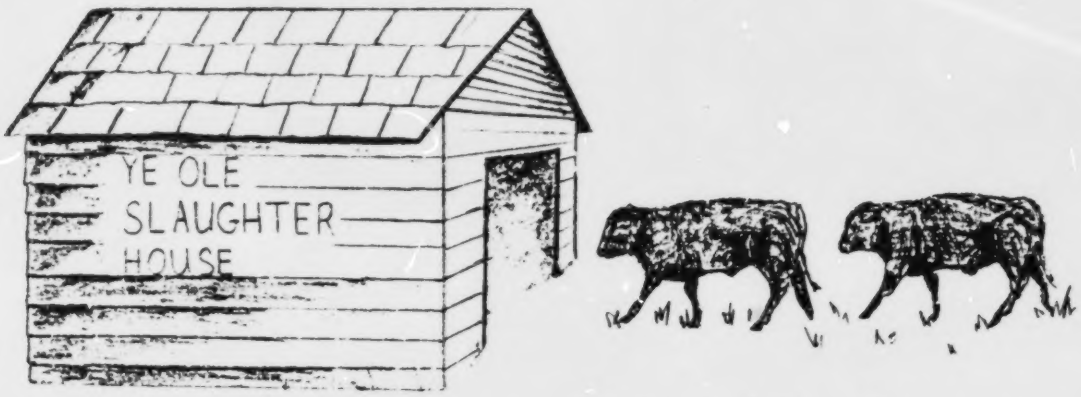



Figure 1. Meat Distribution Channels

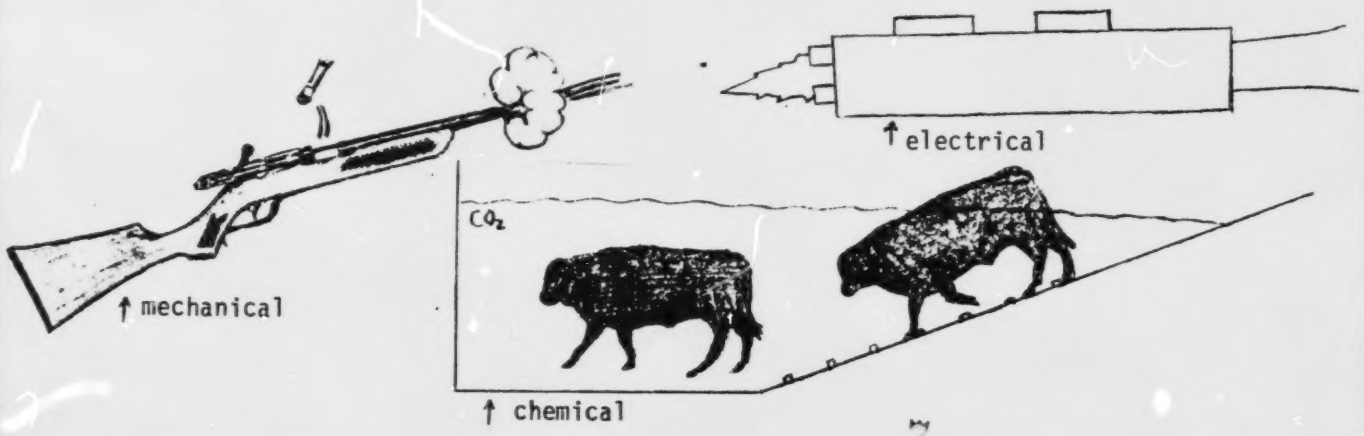
Now let's look at the category, slaughter house (Fig. 1). The purpose of the slaughter house is to take live animals and, through a systemized process, prepare them for distribution to more specialized processing places.




The animals go through an ante-mortem (before death) inspection and are inspected for disease or illness. The animals are then ready to enter the slaughter house.

There are seven slaughtering steps for both beef and pork. These steps are very similar for each kind of animal. The following descriptions are of the pork animal. They are:

1. Immobilization: The Federal Humane Slaughter Act, effective July 1, 1960, provides that an animal must be made completely unconscious with minimal excitement and discomfort. Three methods are allowed to achieve this. (1) the mechanical, (2) the chemical, and (3) the electrical method. The mechanical method may be either the penetrating type (blank cartridge propels retractable bolt into the skull) or the concussion type (mushroom head of bolt is used). The chemical method uses a 65-75% concentration of $CO_2$ (carbon dioxide) in a pit the animals are run through. The $CO_2$, being heavier than air, remains down in the pit. The electrical method involves a probe being applied to the head for one to four seconds.



2. Sticking: Sticking is the process of inserting a knife, such that the carotid arteries and/or jugular vein are severed. This allows for a fast bleed of the animal. The process of sticking is accomplished by inserting a double-edged knife several inches in front of the breast bone directed toward the tail. While inserting the knife, an upward thrust is made until the backbone is struck. The knife must be kept between the shoulders to avoid a shoulder stick.

3. Scalding and Scraping or Skinning: Scalding is accomplished by emersing the animal's body in hot water (150F ± 5°) until the hair slips readily. A round, bell-type scraper is used to remove the scurf, hair, bristles, and dirt. Skinning of hogs is accomplished in a very similar manner to skinning cattle; however, it is not as popular as the scalding and scraping method.

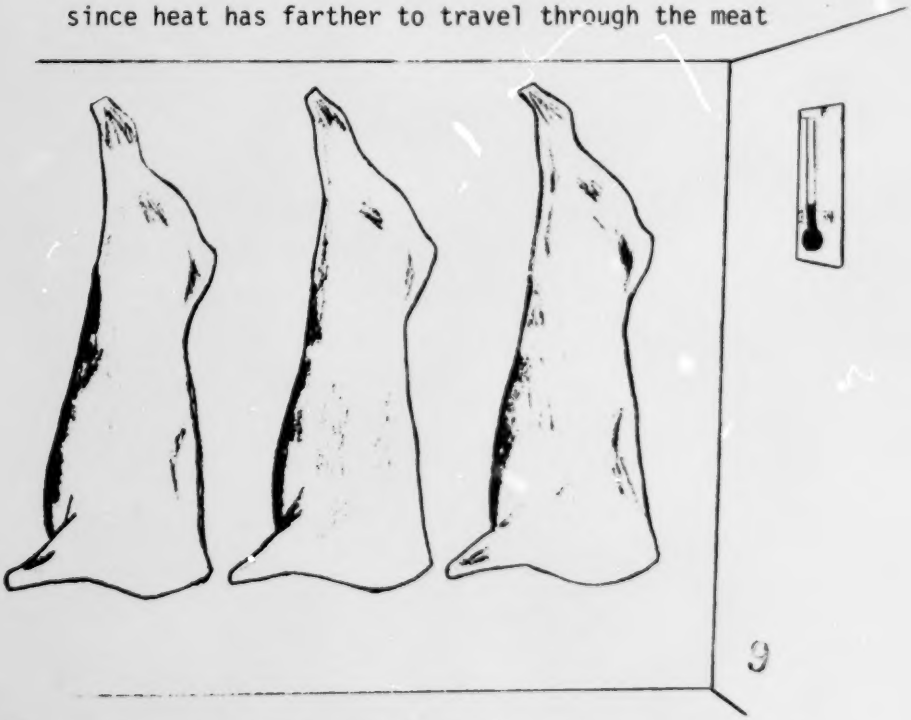
Skinning (beef)

The skinning process starts by skinning out the head and removing the head by cutting through the neck. The next step is removing the skin from the fore and hind legs, making the first line of cut along the backside of each leg down to the midline (belly). After the legs, the side skin is removed. The initial line of cut is made from the neck to the bung along the belly. The skin is removed from the side, and will be completely removed from the back after eviscerating.

When skinning, the process involves holding firmly with one hand and making strokes with the knife between the hide and meat. Extreme care is needed so as not to cut the hide or meat, as this will reduce the value of both. Practice and experience is required for this job to be done quickly and accurately. More mechanized operations will have skinn pullers that will pull the skin off with minimal use of the knife.

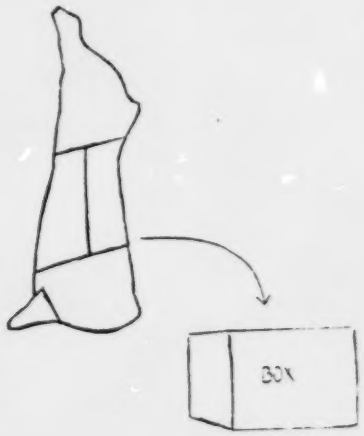
4. Eviscerating: Eviscerating is the removal of the insides. A cut is made from the bung to the neck along the midline (belly) to open the carcass. Care should be taken not to cut the intestines. With the animal in a hanging position, the intestines are pulled out after the bung is loosened. As the intestines are falling out (downward to the floor), the rest of the insides are allowed to follow, such as the stomach, liver, etc. The diaphram is also cut and the lungs, heart, etc. are removed.

5. Halving: Halving the hog carcass is a simple process and may be done with a hand saw or more commonly an electric saw. The carcass is sawed down the middle of the vertebrae.
6. Chilling: Proper chilling of the hog carcass is accomplished by moving the carcass to a chilling room. The temperature of the chilling room should be 34°F to insure thorough cooling of the entire carcass. The inside of the ham should reach 38°F in the first 24 hours to prevent spoilage. This part of the carcass is most vulnerable to spoilage since heat has farther to travel through the meat



to escape to the chilling room than in any other part of the carcass. Thus, the temperature of the chilling room must be cool enough for this heat to escape in the first 24 hours. If several warm carcasses are to be put in a chilling room at once, then the beginning temperature should be several degress below freezing to offset the excess heat of the extra carcasses.

7. Fabrication (pork): The pork carcass is in two halves and ready to fabricated (cut up). Most of the fabricating is done in the plant before being shipped to the next step. The first step in fabricating a pork carcass is cutting the carcass into wholesale cuts. The wholesale cuts are the ham, loin, Boston shoulder, picnic shoulder, and belly. The "wholesale" cuts are also called the "primal" cuts. (See Fig. 2)
Fabrication (beef): The fabrication of the beef carcass is very similar to fabrication of pork. The primal cuts are the chuck, rib, brisket, plate, shank, round, rump, sirloin, short loin, and flank. (See Fig. 3)



The future trend is to "vacuum pack" these wholesale cuts, place them in boxes, and ship them to the retail outlets. This increases ease of handling and "shelf" life of the meat.

The preceding description of slaughtering an animal is only part of the processing of meat. The processing of meat is of little value unless procedures to insure wholesomeness of the meat are followed. The Wholesome Meat Act of 1967 made all state meat inspection systems at least equal to the federal inspection system. This provided for uniform inspection of meat that may be slaughtered in one section of the country and eaten in another.

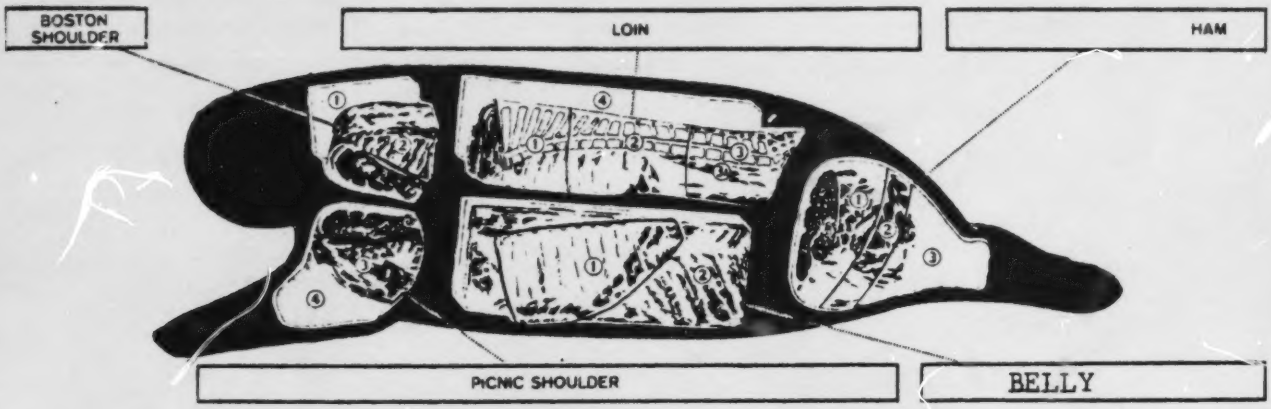



Fig. 2 Pork Primal Cuts

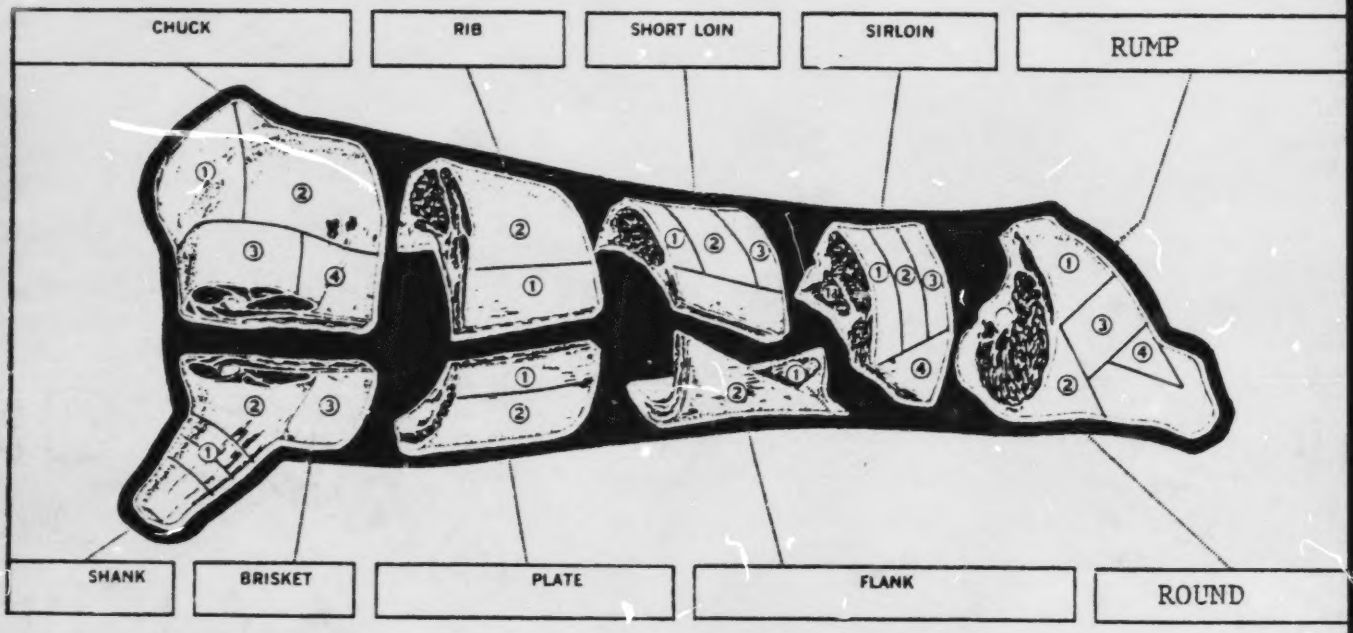



Fig. 3 Beef Primal Cuts

Seven requirements must be met to satisfy the Wholesome Meat Act. They are:

1. Ante- and Post-mortem Inspection: Ante- and/or post-mortem (before and/or after death) inspections are made to detect and remove any unwholesome carcass, part, or organ.
2. Reinspection (processing): Inspection of processed products is made checking such things as ingredients used, chemical quantities, and storage. There are, of course, many other things checked as well.
3. Sanitation: Inspection of procedures concerning cleanliness, control of contaminants, and hygiene practices of the personnel are made.
4. Potable water: When water is used in areas where edible products are slaughtered, eviscerated, dressed, processed, handled, or stored, it must be potable.
5. Sewage and waste disposal control: Inspection is made for proper removal of sewage and waste materials such as manure, paunch contents, trash, garbage and paper.
6. Pest control: This requirement seeks prevention of rodents, insects, or animals from entering facility areas where products are handled, processed, or stored. Prevention measures may include doors, screens, or applying sprays and baits.
7. Condemned and inedible material control: Adequate measures must be taken to control these materials until they are rendered incapable for use as a human food.

These seven requirements are designed to insure wholesomeness of meat as it is processed throughout the slaughtering plant.

CHAPTER 1

T F 1. Future job opportunities for meat cutters are poor.

T F 2. Slaughtered beef is skinned while hogs are scalded and scraped.

_____ 3. Ante- and post-mortem inspection (before and after death) are made:

A. to detect unsanitary employees
B. to detect any malfunctioning equipment
C. to detect and remove any unwholesome carcass, part, or organ
D. to determine if knives are sharp

_____ 4. Pest control means:

A. to keep your dog on a leash
B. to prevent rodents, insects, or animals from entering facility areas where products are handled, processed, or stored
C. to determine if cattle grubs are in the beef hides
D. to eliminate bacteria from the hands of employees

5. What was the main reason why the federal government passed the meat inspection law of 1967?

_____

_____

6. What do beef cattle eat and use to produce beef which is not consumed by humans?

_____

_____

_____ 7. makes the animal unconscious with minimal excitement by a mechanical, chemical, or electrical method

_____ 8. process of removing animal insides

_____ 9. cooling carcass down rapidly by putting in room with temperature near freezing

_____ 10. done to remove blood from animal by severing arteries and/or jugular vein in throat

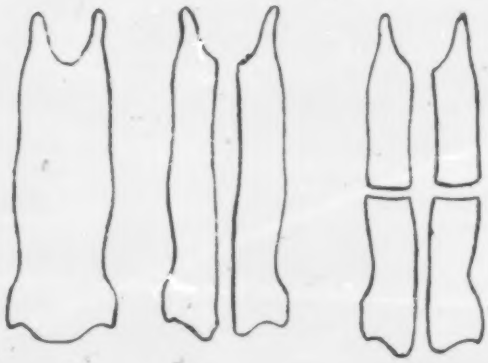
A. scalding
B. chilling
C. eviscerating
D. halving
E. immobilization
F. sticking
G. fabrication

# Chapter Two

# The Retail Process

The retail processing of meat involves cutting the wholesale cuts into retail cuts. These retail cuts give consumers a greater selection of meat cuts to better serve their needs. For instance, one would not necessarily want to buy a hindquarter of beef to broil a couple of steaks at the beach or buy a side of pork for a Christmas ham. Therefore, to better serve the consumer, the retail industry has developed many retail cuts from a few basic wholesale cuts.

A master list of retail cuts was developed in 1972. It lists 314 names of retail cuts of meat for animals commonly slaughtered in the United States. However, for an introduction to understanding the meat processing industry, identification will consist mostly of the kinds of cuts.



An animal carcass is first cut through the vertebrae (backbone) into halves or two sides of meat. Each side is then cut into two parts called quarters. The front part is called a hindquarter.

The differences between the forequarter and the hindquarter are distinct.

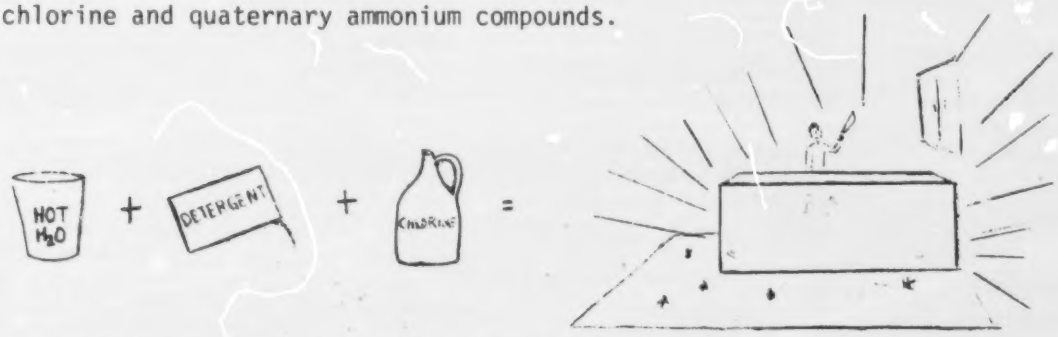
Of the two quarters, the forequarter has fewer high quality cuts. This is due to a greater amount of bone and non-edible meat tissues such as grissel and cartilage. The forequarter consists of several roast type cuts, some steak cuts, and a considerable portion used for stew meat and grinding.

The hindquarter has a greater amount of high quality cuts. This is because of more and bigger muscles and less bone and non-edible meat tissues. The hindquarter consists of several steak cuts, some roasts and a portion used for stew meat and grinding.

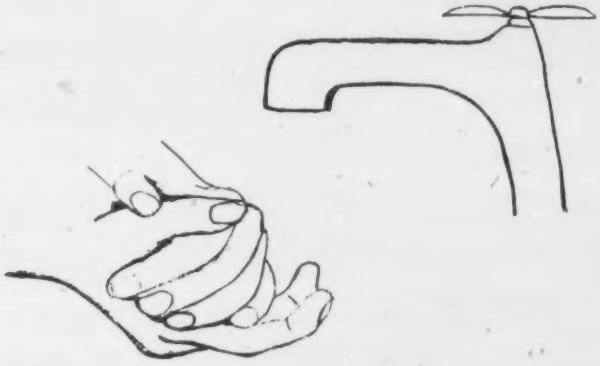
So far we have looked at the slaughtering and federal inspection requirements (Chapter 1) of the meat industry. Also, this chapter dealt with the retail cutting of the slaughtered animals. At this point, an important aspect of the meat industry should be examined--sanitation.

Sanitation involves three main areas: (1) cleanliness, (2) control of food poisoning and disease, and (3) temperature control.

1. Cleanliness is accomplished by thoroughly cleaning the entire room and the surrounding areas, including walls, ceilings, ducts, pipes, vents, floors, etc., as well as all equipment. Washing with hot water, a detergent, and steam is preferable. This should be followed with the application of a permissible sanitizing agent to control microbiological contaminants. Two of the most effective types of sanitizing agents are chlorine and quaternary ammonium compounds.

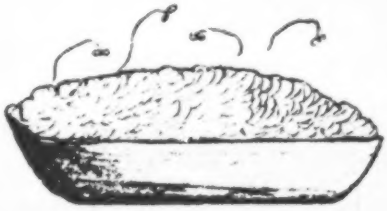



Another aspect of cleanliness is employee personal hygiene. Changing to clean aprons or protective covering often and washing hands with a bacterial dip is helpful.



2. Food poisoning and disease can be reduced considerably by control of human or animal waste matter, saliva, and decayed or spoiled food. These are three of the main causes and spreaders of food poisoning and disease.

   Another way of spreading disease is allowing fingers and hands to come in contact with contaminants, then touching food without a thorough washing of the hands and fingers.



Control of flies is an excellent way of reducing disease. Flies spread disease two ways: (1) wiping their feet on food after tracking through sewage and other wastes, and (2) by regurgitating on its food. The fly cannot chew; it must suck up its food in liquid form. It vomits on its food, dissolving it, then sucks up what it can leaving behind disease-spreading bacteria.

3. Temperature control is critical. Holding temperatures below 40°F is absolutely necessary. The best temperature for meat is near the freezing point at 28°F. Systematic and frequent checking of all thermostats and thermometers will ensure accuracy of the temperature. Relatively small variations in temperature can drastically affect storage life of the product. Spoilage develops at least twice as fast at 40°F as at 32°F and at least four times as fast at 50°F as at 32°F.

## CHAPTER 2

1. Explain the difference between wholesale cuts and retail cuts.

2. What is the major difference between the forequarter and hindquarter cuts of meat?

3. Which quarter has the most steak cuts?

4. List the three (3) main areas of sanitation.

5. Briefly describe each area.

# Chapter Three

# Beef Evaluation

In recent years attempts have been made to standardize and make uniform the grading of beef. Prior to 1976, beef carcasses could be graded either for quality or yield or both. As of 1976, all beef must be graded for both quality and yield.

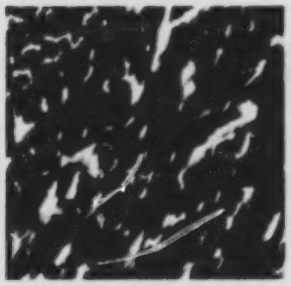
Beef quality grading is an evaluation of the factors that affect the palatability characteristics of tenderness, flavor, and juiciness in cooked beef. The two major factors to determine the beef carcass quality grade are: (1) degree of marbling, and (2) degree of maturity. Additional factors--color, texture, and firmness of lean in the ribeye muscle--are used to determine the final quality grade.

Marbling is the amount of fat distributed within the lean. There are 10 degrees of marbling as shown in the illustration, Chart I. The degree of marbling is estimated on the lean cut surface of the rib-eye muscle at the 12th rib. Marbling increases the tenderness, juiciness, and flavor of the meat; however, excess marbling above a small degree gives minimal improvement in the quality. A desirable cut of meat would have some marbling; yet, an excessive amount would not be needed for high quality.

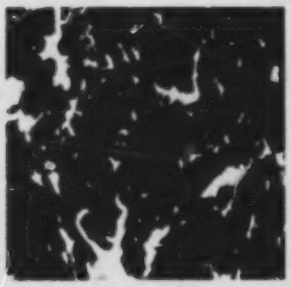
Maturity is an estimation of the age of a beef animal. Maturity is estimated by: (1) observing the color of lean, and (2) observing the cartilage and bone of the vertebrae in the backbone and the ribs. The color of the lean as shown in Figures I, II, & III illustrates how the color turns progressively darker with advancing maturity. Young feedlot cattle will

# DEGREES OF MARBLING

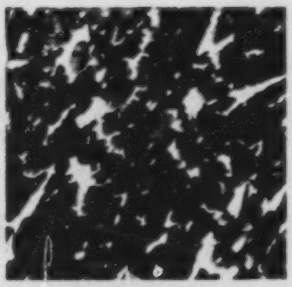
Since marbling is such an important factor in judging and grading beef, the following pictures illustrate the lower limits of eight of the degrees of marbling (abundant through traces) referred to in the official United States Standards for Grades of Carcass Beef. In grading, positive consideration is given to marbling through the upper limit of "abundant". That amount is depicted by the illustration of the lower limit of "very abundant". The lowest degree of marbling, "practically devoid," is not illustrated.



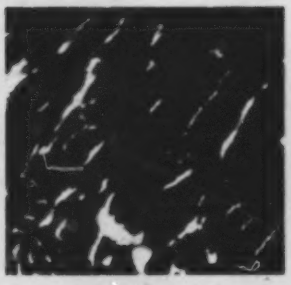
1—Very abundant



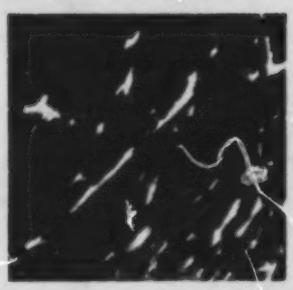
2—Abundant



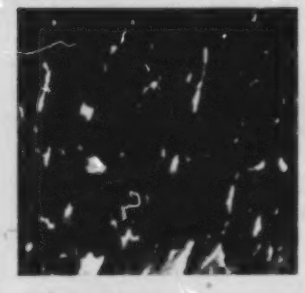
3—Moderately abundant



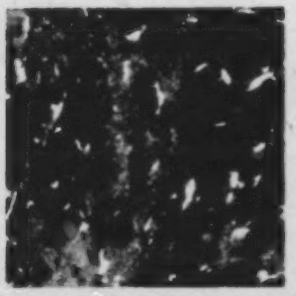
4—Slightly abundant



5—Moderate



6—Modest



7—Small

8—Slight

9—Traces

SOURCE: National Live Stock & Meat Board, Meat Evaluation Handbook, 1977.

Illustrations adapted from negatives furnished by New York State College of Agriculture, Cornell University

typically have a bright, cherry red color; whereas, the mature cow will have a deep, dark red color. The young fed cattle generally will yield more tender meat than older cattle. Therefore, a bright, cherry red color is desirable for the color of the lean. The second way of estimating maturity is observing the cartilage and bone at the ends of the vertebrae in the backbone and the ribs. The cartilage ossifies (becomes bone) and bone whitens (becomes harder and whiter) as the animal gets older. A typically desirable carcass would show soft cartilage and some ossification on the vertebrae. The ribs would show some loss of redness but would still have a reddish or pink color.

Beef yield grading is based upon the yield of boneless, closely trimmed, retail cuts from the four main wholesale cuts--round, loin, rib, and chuck (see Fig. 3, Ch. 1). These four wholesale cuts account for 75% of the carcass weight but 90% of the carcass value. Four factors are used which have the greatest influence on carcass yield. They are: (1) fat thickness, (2) kidney, pelvic, and heart fat (KPH), (3) ribeye area, and (4) hot carcass weight. These factors are put into a formula that gives a numerical value in the range of 1 to 5 (1 best, 5 poorest). This value is called a yield grade. With every yield grade there is a corresponding percentage of retail cuts. This percentage of retail cuts gives the amount of retail cuts available from a carcass and, thus, a dollar value can be figured.

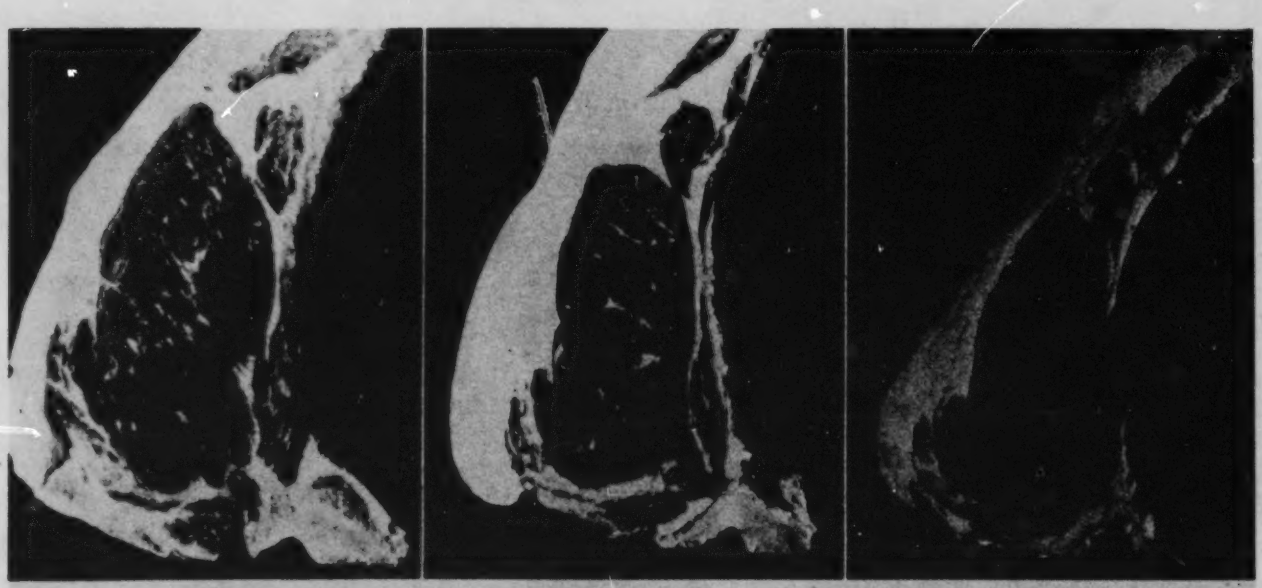
The first factor, fat thickness, is a measurement of thickness of fat at the 12th rib, over the ribeye muscle. The figure estimates the total carcass fat. A measurement indicating a greater fat thickness means a greater amount of fat to be trimmed off, which lowers the poundage of retail cuts available for sale.

Kidney, pelvic, and heart fat (KPH) amounts to approximately 3.5% of the carcass weight. This fat will be removed, thus, lowering the poundage available for sale as retail cuts.

The ribeye area is an indicator of muscling in the beef carcass. The ribeye muscle is the long muscle down the back on either side of the spine. Just as the thickness of back-fat indicates the amount of fat that will be trimmed off, the area of ribeye indicates the amount of lean meat available for the retail cuts. Thus, the larger the ribeye area, the more the muscling, and the more lean meat for salable retail cuts.

The carcass weight measurement used is called the hot carcass weight. It is taken after slaughter following the dressing procedures.

In summary, standardizing and unifying the grading of beef has been accomplished by use of a quality grade and a yield grade. The quality grade evaluated two major factors--marbling and maturity--that affect the palatability of cooked beef. The yield grade estimated the yield of boneless, closely trimmed, retail cuts from the four main wholesale cuts of the beef carcass. When pricing or ranking carcasses a combination of both quality grade and yield grade are taken into consideration. Today, Choice Yield Grade 1 or 2 carcasses are in the greatest demand.



Young Intermediate Mature

## CHAPTER 3

1. As of 1976, beef must be graded for both _____ and _____.

2. What is marbling?

3. How is maturity estimated?

4. What is a desirable color for the lean of beef?

5. List the four (4) main wholesale cuts beef yield grading is based upon.

6. List the four (4) factors that have the greatest influence on carcass yield.

7. Briefly describe what each factor means.

# Chapter Four

# Pork Evaluation

In the last chapter we discussed beef carcass evaluation. In this chapter we want to examine the factors of pork carcass evaluation.

Pork carcass evaluation is based on (1) the expected yield of the four lean cuts--ham, loin, arm picnic, and blade (Boston) butt (see Fig. 3, Ch. 1), and (2) factors related to the quality of the lean--firmness, color, and marbling.

The lean cut yield is expressed as a percentage of the carcass weight. The calculations for this method involve the amount of muscling in the pork carcass and the amount of excess trimmable fat. The degree of muscling is more important when the fat content is similar between two carcasses, meaning the carcass with the larger and thicker muscling will have a greater yield of lean cuts.

The figure to the right illustrates five of the six degrees of muscling recognized in the standards. From left to right they are: very thick, thick, moderately thick, slightly thin, and thin. The sixth degree, very thin, is not illustrated.

Though the muscling is important, the amount of excess trimmable fat is even more important. The backfat thickness on a pork carcass is associated with approximately 50% of the variation in estimating percentages of lean cuts. Since the fat is removed during the cutting and trimming process (fabrication), the way a meat establishment cuts and trims its meat becomes important. The variation in yields of lean cuts may be due largely to the method of fabricating the pork carcass. This means the amount of fat allowed to remain on a cut of meat may be different from one grocery meat department to another; thus, giving different yields at different meat departments.

Since the percentage of lean cuts may vary due to the way the meat is cut or trimmed, another method for evaluation of the pork carcass has been developed. This method is percentage carcass muscle.

The percentage carcass muscle is based entirely on objective measurements. It is calculated from an equation that includes hot carcass weight, loin eye area, and backfat thickness at the 10th rib. Because the percentage carcass muscle is calculated from entirely objective measurements and is not influenced by cutting and trimming variations, it is a better indicator of value for the pork carcass than cutout percentages.

The factors related to quality of the lean are firmness, color, and marbling. A cut surface from a major muscle is used to evaluate the quality of the lean. Usually the eye muscle at the 10th rib is the cut surface site.

Firmness of the lean should be as stated--firm. The lean should not be excessively soft. A uniform bright grayish pink is desirable for the color of lean. The marbling should be uniform. In addition, the fat should be white in high quality pork.

## CHAPTER 4

1. What is pork evaluation based on?

2. Explain why the amount of excess trimmable fat is more important than the degree of muscling.

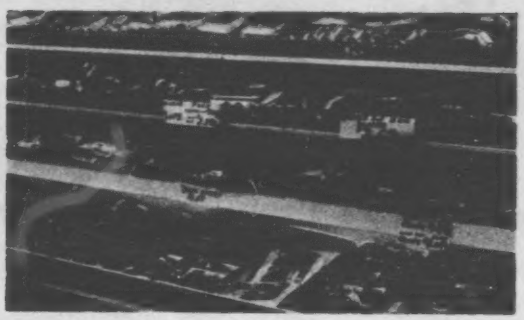
3. Explain why the percentage carcass muscle method is not influenced by cutting and trimming variations.

4. What is a desirable color for pork lean?

# The Meat Market

Building neat and clean.

Luncheon meats prepackaged for convenience.

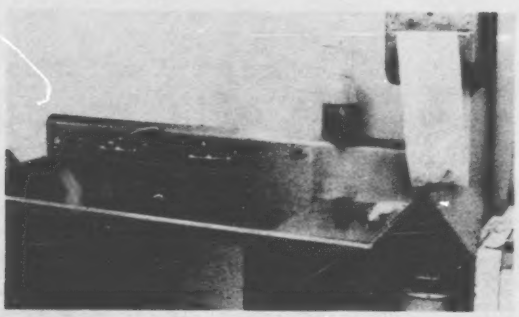


Cut meat display.

Poultry is available whole or cut up.

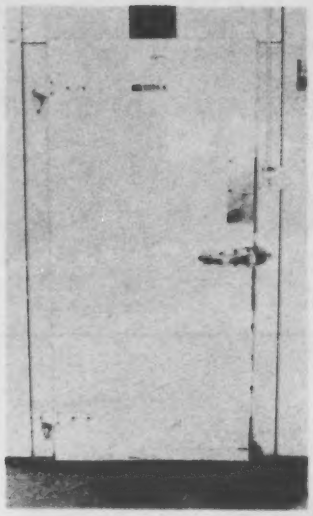
Meat department as seen by the customer.

A look behind the counter.

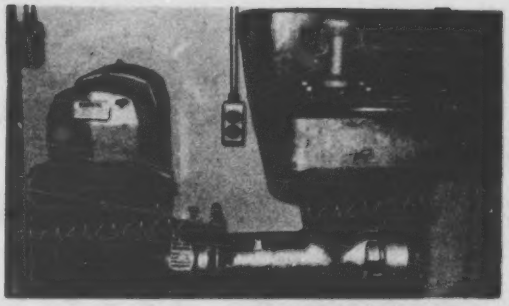


Standard operating equipment.

Safety procedure: clean sawdust on floor to avoid slipping (scraps of meat and fat cause slick floor).



Freezer



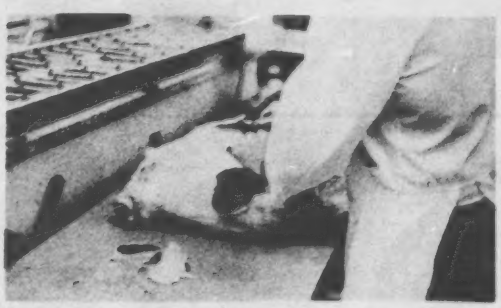
Hamburger grinder: meat is placed in upper tray and comes out at lower left of machine. Notice handle sticking up in tray--used to push meat into grinder, keeping fingers from getting into machine.

Meat is wrapped in a clear wrapping.

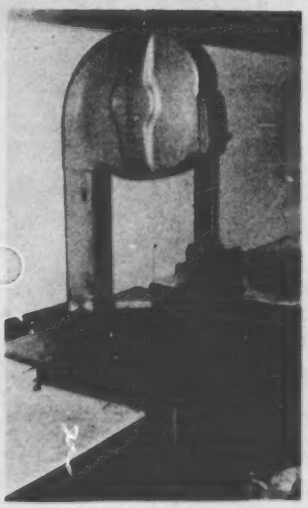
Compactly stored boxes of wholesale cuts of beef. This method replaces the old method of hanging carcasses.

Hooks used to hang carcass (before store switched to boxed storage).

Meat cutting tools: saw, knives, steel (long, pointed), & meat cleaver. Steel used to sharpen knives.

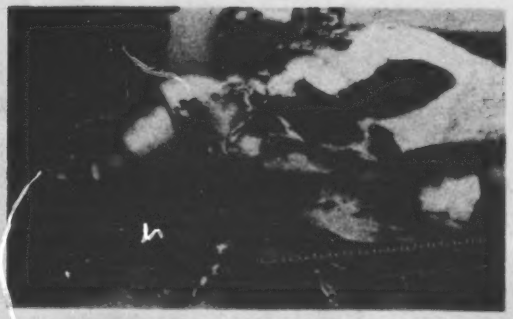


Removal of excess trimmable fat.



Band saw used to cut large wholesale cuts.

Cutting from right to left side of employee Notice hands are clear of blade.

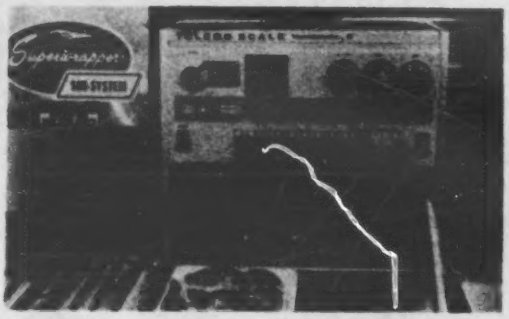


Saw in action--notice path the blade makes.

Use of scraper to remove bits of bone left by band saw.

Automated wrapping machine wraps, weighs, & prices. Employee pulls wrap up and over package and tucks edges under.

Cut portions placed in styro tray for wrapping.



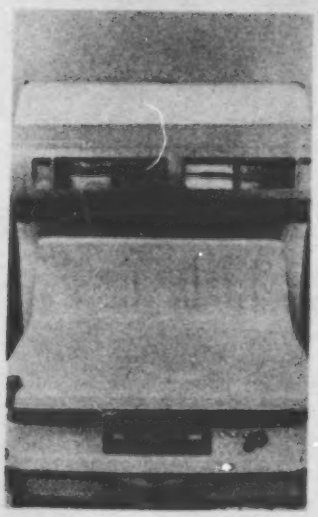

Wrapped package rolls to scale to be weighed.

Package falls into tub--ready for meat counter.

Weight and price (already calculated) are printed on stamp which is placed on package.

Meat slicer can cut meat very thin or thick--commonly used for luncheon meat.

Bacon slicer makes uniformly spaced slices.

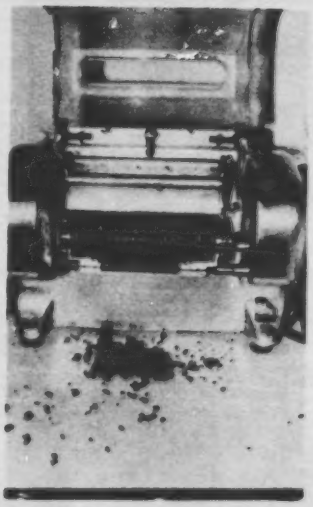


Meat goes from top down through little knives.

Scale--useful for weighing large cut of meat.

Now you know what goes on behind the meat counter.

Right hand holds meat in slicing tray; left hand catches piece sliced off.



Meat tenderizer breaks up connective tissue.

Meat counter--final destination after meat has been cut, wrapped, weighed, and priced.